SCIENCE

VOL. 81 FRIDAY, MARCH 8, 1935 No. 2097

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.
Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

MAN, THE GREAT INTEGRATOR[1]

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FROM the point of view of the circulatory system we may think of one of the higher mammalian organisms in terms of the systole and diastole of the heart. With the heart's contraction a powerful stream of blood is forced into the systemic circulation to find its way through vessels of ever-decreasing diameter to smaller and smaller areas of irrigation. In this way the oxygen carried by the blood corpuscles is distributed to the most remote portions of the body. Then when the force of this contraction has spent itself the heart pauses for an instant and during this pause receives from all these outlying districts of the body the blood which, having been deprived of its oxygen, has by another mechanism been circulated through the lungs to receive a new supply, and when this is done a further contraction sends this new supply along the same paths as before. This constant pulsation which distributes the vital fluid is characteristic in a sense not only of all living matter but of everything organic and inorganic in the cosmos. Wherever we look we find motion, and wherever we find motion we find rhythm or periodicity of some sort. We might therefore reasonably expect, and as a matter of fact do find, that these same principles which control elsewhere are observable in the field of psychological phenomena. The particular aspect of these phenomena to which I would draw your attention are the systole and the diastole of human knowledge, which expresses itself in the constant tendency, so well manifested in the field of medicine, to the development of medical specialities and in the field of science to the separate development of the various sciences. It is the tendency to differentiate, on the one hand, and on the other the reciprocal tendency to bring together, into a common reservoir, as it were, by a process of co-

[1] Address at the opening session of the American Association for the Advancement of Science, Pittsburgh, December 27, 1934.

ordination and integration knowledge from several or from all fields. These two tendencies of differentiation and integration which we see exemplified in this manner are not separate and distinct processes but are the two aspects of advancing knowledge, and it is the recognition of this fact and of the part that man plays in this forward movement about which I wish to speak briefly to-night.

In the first place, I call your attention to the fact that this way of looking at development and evolution gives us a different picture of the organism from the one that maintained during the last century. At that time we were thinking, not of a constant flux of energies without rest or equilibrium at any point, but we were thinking in terms of static pictures. Medicine in particular had developed a concept of the human organism that was largely dominated by the revelations and discoveries emanating from the autopsy room. We looked through the microscope and we saw pictures beautifully colored of cells and fibers, and we jumped to the conclusion that such cells and fibers as we saw there actually existed in the living being, and so there was built up a concept of living organisms which really as a condition precedent demanded that they be dead. It was the mosaic theory, the theory that the organism was composed of cells, that the cells united to form tissues, and the tissues to form organs. In the nervous system we found the reflex arc to be the unit of structure; and in the mind, by a parity of reasoning, it was the sensation. Somehow we believed that a number of cells could be brought together by a process of addition to form tissues and organs, that a number of reflex arcs could be added together and when enough hundreds of thousands of them had accumulated we had the mammalian nervous system, that a number of sensations could in the same way be put together to form a mind. This resulted in a sort of kindergarten idea of a living organism, based somewhat, I suspect, upon the foundation of the five special senses, and gave us in the final analysis a picture quite in harmony with the smug complacency of the mid-Victorian era. The unfortunate thing about it all is that we still find it easier to think in these terms than we do to think in terms of the more modern concepts because we were brought up with these old ideas; they formed part of the habits of our more youthful thinking, and they have been imbedded and preserved in the structure of our language. It requires, therefore, a more than ordinary wrench with the past to free ourselves from these hampering traditions and to be able to think and feel and act as if they were no more.

In the field of general science these traditional ways of thinking have received in recent years a number of very serious jolts. The constitution of matter as made up of molecules and atoms has had to give way to the discovery of a sub-atomic world of bewildering complexity. Along with this new discovery there disappeared the idea of the fixity of the chemical elements and with the discovery of radium emanations, the dream of the old alchemists came true when elements were transmuted one into another. Carnot's principle, which had held sway for so long and which taught that the universe was cooling off and gradually settling down to equilibrium and death, has been called in question by the cosmic rays of Millikan if in fact life itself does not contradict it; and in the field of the study of mind it has been found that beneath and beyond and all about the brightly illuminated spot which we ordinarily think of as consciousness there is a field, a twilight zone if you will, of what we call the unconscious, wherein the play of forces which we call motives, instincts, trends, drives, wishes, have their sway, and an understanding of which is necessary to the understanding of man.

The difference between these recent occurrences and the revolution in our ideas of the cosmos which came about, for example, as a result of Galileo's observations and teachings, is that in the latter case they were received not only with incredulity but with antagonism, with fear, with hatred, and with a sense that the old order must be preserved at any price or disintegration and chaos would reign supreme in this world and disaster in the next. These new observations, however, have all of them come about as a result of scientific research with no great upheaval of opposing public sentiment and with, on the whole, all along the line a general acceptance of the observed facts as these facts were sufficiently verified. To my mind the most significant single feature of our civilization with its many advancing scientific frontiers is the comparative ease with which to-day it is possible to break with tradition when tradition has ceased to serve us.

May I at this point remind you that the field I represent is the field of psychiatry, and that what I wish to do is to give you some little idea of how in this field we have broken with limiting and crippling traditions and as a result have come forth into a new world of thought and knowledge, and something of what we have found, something of its significance for an understanding of man as an integrator.

In the first place, I have suggested only that one of the main features of advance in the psychological field has been the discovery of a great field of mental activities outside of the field of conscious awareness, a region which is ordinarily termed the "unconscious" but which by analogy with the body structures I like to speak of as the "organ of the unconscious." In this field we have discovered many things, some of which at

least have been vaguely known for a long time but which now, upon rediscovery, receive a new lease of life and a greater understanding. We have discovered man more truly as he really is rather than as we previously knew him, disguised by the veneer of civilization and culture. We have realized the necessity of considering the origin and the historical background of man as he appears at present; and while this examination has not deprived man of his many excellent qualities, it has taught us that he has potentialities which in the past we have never wished to recognize, much less to dwell upon. Above all, it has taught us that we are all kin in a much more concrete way than we had heretofore supposed, that our respective pasts are so long that our presents are inconsiderable as compared with them, and that this past is what we possess in common; in other words, that the differences by which we know one man from another, our friends from our enemies, people of different races, religions and languages—all these differences, the individual differences of the psychologists and these others, are inconsiderable as compared with our likenesses which have been laid down as permanent possessions as the result of millions of years of preceding life experience in conflict with a hostile environment, and that the reason that we are here to-day is that by and large this struggle of life as it has pushed its way upward through the past eons of time has been a successful one because those results of experience which have had survival value have been somehow preserved. Let me dwell briefly upon some of man's qualities as displayed by a search into his unconscious motives, and let me give some examples to illustrate what I mean.

In the first place, it is essential from our point of view in questioning the organism to realize that those questions must be addressed to the organism-as-a-whole rather than to some of its differentiated structures, and that what we need to know about are the purposes of the organism in the broadest possible terms and how these purposes are striven for and attained or missed, and it is only at the psychological level that these purposes manifest themselves with any clarity. If we vision the organism battling with a hostile environment we can see that its most general purpose is to succeed in the battle, by which is meant to preserve its own life, to perpetuate the life of the species, and perhaps less important but nevertheless to be considered at least in the realm of human life, the gaining of some form of pleasure, happiness, satisfaction, self-expression as a result of the conflict —the seeking of pleasure and the avoidance of pain is the simple way of putting it. In making this statement I have already differentiated two great regions: the environment, or the world without, the most important component of which for man is his fellow men; and the world within, the mind, with its ideas, its feelings and its tendencies expressed through the body. The conflict of the organism with the environment is a conflict that has its reflection or repercussion in the world within, so that as we expect antagonisms without so we must expect antagonisms within. We are dealing here probably with a concept as generic in type as that of the energy concept at the basis of the law of action and reaction. Life goes forward as the expression of conflict and continues as long as the balance is on the side of success.

The reciprocal relation of the world within and the world without is the most significant feature to which I wish to direct your attention. In the first place, it is fair to assume, as I already have, that in the history of man's development his successes should somehow be preserved. The main features of the conflicts of the past have been the building stones with which he has scaled the heights, and so it is not strange that we should find the remnants and indications of these important events laid down in the structure of the mind as well as we see them laid down in the structure of the body. We have the indications, the bodily history preserved not only in the embryology of man but also in various developmental anomalies and peculiarities with which we are all more or less familiar. There is as truly an anatomy and a physiology of the mind, represented by its structures and functions, as there is an anatomy and physiology of the body; and there is as truly a genetic psychology as there is an embryology; and there is as truly a paleopsychology as there is a paleozoology or a paleobotany. As there are archaic structures in the body so there are in the mind, and when man comes to civilization he carries with him all these indications of his past at the psychological as well as at the somatic level. So we see from this point of view that all the forces of the cosmos as they have been concentrated in the conflict between the organism and the environment have resulted in definite structures of mind and body which have been preserved, in miniature as it were, and give us the picture of an organism which at each moment is reacting with the precipitates of its entire past to the present situation. These purposes of the organism as we see them represented when we look at it in this way orient us in an entirely different way towards the problem of man. Instead of viewing him from a purely descriptive level there now inevitably come to the forefront meanings and values. Life does not present simple, direct situations capable only of a single interpretation. We are always torn between our instinctual tendencies, on the one hand, and the necessity for their adjustment in a satisfactory way to the situation as it exists at the

moment. Here we are confronted with questions of choice, matters of judgment, and meanings and values are the deciding factors. It is inevitable, therefore, as you see, that man's desires should come up against, as it were, all manner of obstacles in his environment, and that therefore his main objective in life must be to modify that environment, to bend it to his purposes, and in this way to bring to pass his desires. Here we have at once an explanation of the growth of science, for science has this objective above all others; and not only that, but we have an indication as to why different individuals choose different careers, for it is because they each of them are different that they bring a different pattern of personality to bear upon their present problems and are driven to their choice by a necessity resulting from the clash of this different pattern with the forces with which it is in conflict. So we have a right to suppose that the reason why a man becomes a chemist, why he becomes a physicist, why he becomes a biologist, are all questions that can reasonably be asked of the organism, and that we may expect to find answers to these questions in the make-up of the individual concerned. In fact, we may go still a further step and say that man's interpretation of his environment is dependent upon what he wishes to accomplish. In other words, he interprets his environment dependent upon how he intends to react to it. For example, a book to one man is something from which he may obtain certain information, to another man it is a volume which replaces one that has been lost and therefore completes a set, to another it is a beautiful thing which will look well in a certain bookcase, to another it is something to be reproduced by the processes of printing and binding, and so on—to each one the environment is perceived and apprehended in accordance with the ways in which he would act upon it and mold it to his purposes. So that we see man coming to the problems of his life with the accumulations of the past and meeting them in accordance with the purposes which he desires to bring to pass. That "man is the measure of all things" is therefore no longer just a phrase nor yet a commonplace, but is a fact of tremendous significance and importance and one that must fundamentally modify our way of thinking of him in all his different aspects. You will see, therefore, that I think of man, an individual man, for example, as a point where at the moment the forces of the universe are nucleated in a particular way, and where they are working themselves out in accordance with certain laws. Man is one of the products of the cosmos, he is not something which has been added to it; and therefore, as we might expect, he expresses within himself the laws which operate elsewhere in the cosmos. The functions of mind can be thought of best in terms of energy, although at present we are unable to differentiate and separate this energy and measure it. I can not, however, but feel with the author who says: "Considering the impossibility of defining the exact line of demarcation between animate and inanimate matter, it is astonishing to find so much stress laid on the supposed fundamental difference between vital and non-vital phenomena."[2] Man thus becomes the final integrator of all the laws, physical and vital, that have led up to his development and which he manifests in the very fact of living.

Most physical phenomena, as I have already indicated, can be expressed in the framework of certain dimensions: the large masses with which the astronomer deals, the smaller masses familiar to the physicist, the still smaller ones of the chemist, and then the world of the sub-atomic which is beyond the field of vision and in which still different laws seem at the moment to be possible, where perhaps cause and effect, as we generally know them, no longer rule, where the principle of indeterminacy takes the place of that of determination, then there is the so-called "world of neglected dimensions"—with which words the colloids have been referred to. And then we get finally to the field of psychology in which dimensions as we ordinarily know them do not seem to be applicable in the ordinary sense, with the exception perhaps of the dimension of time. Here we are dealing in a field that is quite unique, except that whatever occurs in this field occurs in accordance with the laws of the field. Whatever finds its way into the psyche is governed by the laws of the psyche, but because it has those characteristics which defy measurement in the ordinary ways with which we are familiar it is quite probable that it may require modifications in methodology which will have to be developed in order to wrest from it its secrets; and in one respect this possible difference of methodology will have to be borne in mind, and that is in the old sense that man in order to understand himself is in the unique position of being both the observer and the observed. He has, so to speak, to lift himself by his own bootstraps. This has always been a vexatious, and, so far as I know, an unsolved problem. It has been written of, thought of and argued; many suggestions have been made but none of them satisfying. I only have this to offer in this peculiar situation in which man finds himself when he wishes to understand himself, and I refer to what I have already said about the way in which man perceives the universe about him, namely, in accordance with the plan of action which he intends to develop with reference to it, or, in the words of Bergson,[3] "our perceptions give us the plan of our eventual action on things."

[2] Stephane Leduc, "The Mechanism of Life."

By development, by history, from any way we look at the organism, it is essentially a going concern. Meanings are without significance except as they express themselves in actions. Perceptions are without significance unless ultimately action results from them. Our knowledge, so-called, of the world about us, is a knowledge which has developed and been organized for the purpose of our actions upon that world. If, therefore, we are content only to think about and argue about the difficulty man may have because he is both observer and observed, we will find ourselves with an unsolvable problem from which we can not extricate ourselves. If, on the other hand, we undertake to carry out the design on which we are built, if we yield to the demands of our structure, if we undertake to do something about these various problems, somehow there will be wrought through the strange alchemy of life results which will advance our knowledge and increase our effectiveness. While this may seem the best we can do it is not enough. We must not permit ourselves to be stalled into inaction by the sterilizing magic of words but must overcome such difficulties by attempting to solve the problems that life presents to us by doing something effective about them.

Now let me briefly indicate some of the more outstanding contributions that psychiatry has to make in regard to the principles I have outlined. I spoke of the reciprocal relations of the world within and the world without. It is quite understandable that when the world without is destroyed chaos should reign within the mind. At times of great catastrophes such as earthquakes, and especially, as we have seen in the world war, when enormous shells explode in the neighborhood of an individual, we find the result to be a feeling of utter helplessness as all the usual and familiar stabilities of the world disappear. The very earth itself trembles and no longer offers a stable foundation. The enormous destructiveness makes our lives so insignificant that complete annihilation seems imminent. Terror seizes the victim, and complete confusion reigns in what had previously been an orderly world. It is perhaps not so understandable, except in the face of an acceptance of the idea of reciprocal relationship that I have mentioned, that, when the world within is threatened by disease, when in fact as a result of progressive organic disease of the brain it undergoes a process of disintegration, under these circumstances such a process should be accompanied by delusions which we term nihilistic delusions and which are expressed by the patient in terms of the destruction of the universe. He feels that all things about him are crumbling away and disintegrating. He feels the apprehension, the fear, the confusion, which such a disintegrating universe forces upon him. And so he comes by a different route to the same net result reached by the individual in the midst of a great catastrophe.

On a par with these phenomena are the much more familiar symptoms that we find very frequently in the very early stages of mental disease. I refer particularly to the symptom that we call "depersonalization" but which is more commonly referred to as "confusion." In this state of mind the patient feels strange, as if something had happened to him. He is uncertain, acts perplexed. The feelings of strangeness may seem more particularly as if they applied to himself or to the world about him. He has lost the feeling of definiteness and security with which he contacted the world previously. He feels perhaps that he is not himself, he has lost his feeling of personal identity. These symptoms can be understood in the light of what I have just said about nihilistic delusions when it is realized that we think of psychoses as being, in the first place, a retreat from the world, and, in the second place, a distortion of that world. Therefore you will see that under these circumstances the patient who is moving into a psychosis develops as his first symptoms disintegrations of a mild degree of both the world within and the world without. There reciprocal relations maintain as they did in the more malignant situations referred to above. One does not change without the other.

In the face of these principles, too, it is not by chance that, in the conditions which we term "mental disease," the method of thinking, the forms and structure of the thought processes and actually to a considerable extent the very content of thought itself take on the characteristics of the thinking of children and of primitive peoples; for, after all, has not man passed through the period of childhood, both individual childhood and the childhood of the race, and is it strange that he should carry with him characteristics pertaining thereto? And when disease involves his mind we find that these characteristics appear as symptoms. This change is expressed by a movement in the direction away from the reasoning, differentiation and abstraction of highly developed thought processes toward forms of expression in which feeling, concreteness and perception dominate.[4] If we examine such an organic disease of the brain as aphasia in some of its forms we may rather unexpectedly find the same principle to hold. We have been so imbued with the localization theory of function of the last century that we are hardly prepared for such phenomena. We have been thinking of cortical cells as if they had only specific functions to perform and the

[3] "Creative Evolution."

[4] Alfred Storch, "The Primitive Archaic Forms of Inner Experiences and Thought in Schizophrenia."

destruction of these cells would result in the destruction of these very specific functions. This concept is not by any means wholly wrong, but it is only a partial truth, for when we do get aphasias as a result of destructive processes of the brain we find that we do not have the simple dropping out of exceedingly concrete and well-defined functions, but a regression to a simpler way of expressing ourselves through the medium of language. Perhaps no function illustrates better than language the fact that man is not the result of a process of simple addition in accordance with what I have described as the mosaic theory of structure. Language, like the simple reflex, is by no means an isolated or rigidly circumscribed phenomenon. As "the reflex," in the words of Coghill,[5] "is in its genesis dominated by the total behavior pattern," language is an expression not of a few closely related cortical brain cells but of the whole individual, and when the mechanism by which this function is translated into speech is interfered with this function as a whole drops to a lower and more primitive level consistent with the reduction in complexity and the simplification of the remaining available anatomical structures and physiological mechanisms. Such examples as these might be multiplied indefinitely, but I have simply quoted these two to indicate how far flung are the possibilities of the interpretation of human behavior and the nature of man by way of the route of psychopathology.

Let me reverse the direction of my thinking and, instead of speaking of what may accrue to the understanding of man by way of psychiatry, indicate some of the things which the psychopathologist, particularly the psychotherapist, may hope for from the field of general science, particularly biology. In the experimental work of the biologist certain results have stood out in recent years which appear to have attracted little or no attention from those who are interested in modifying human beings by various methods of therapy. I refer to the experiments which have been made in the modifications of animals by various changes in their environment. Take, for example, the wide variations in appearance which have resulted in the same species of butterflies from living under different conditions of temperature and moisture, types of modifications which have been duplicated in various ways in the laboratory. Think of the control of the sex in pigeons by causing their metabolic rate to vary. Think of the modifications in the development of the claws of shrimp so that the large claw can be at will grown upon either the right or the left side; and the various monstrosities that can be brought to pass in the development of such animals as the fish by the modification of the chemical constituents of the solutions in which they grow and the arresting of development at different points. And most astonishing of all are the transplantation experiments by which tissues transplanted from one region of a developing organism to another develop into the structure that would naturally be produced in this location. What it becomes depends on where it is—its environment.

Such results have served to change our way of looking at the problems presented by heredity and environment and we have come to begin to think of these two terms as what I call ambivalent opposites, as only two different aspects of the same process. The significant thing is that when we have hereditary structures hereditary possibilities can only be realized in fact if the organism is exposed to the type of stimulus emanating from the environment which causes their development. In other words, a person may inherit a quality without ever showing any signs of it at all, simply because he has never been exposed to the proper stimulus. Assuming that such a characteristic as ability to play the violin were transmitted by heredity, it is understandable that an individual might inherit such an ability but never realize it because he never had a violin to play upon. The significance of these experiments and this new point of view, I think, is very great for human beings; for it means that, as marvelous as the whole integrating process which has culminated in man has been throughout time, resulting as it has in the concentration of all the possibilities of adult realization in submicroscopic packages of probably fairly definite chemical make-up known as genes, nevertheless these minute results of life's experience laid down in these forms can be conceived to have still greater possibilities than have ever been realized as the result of the sort of experiments I have indicated. This all means that whereas our hereditary pattern is fixed to a certain extent, it is only fixed under conditions of life such as we ordinarily meet up with and that entirely different conditions might result in the realization of possibilities undreamt of. A whole new field of possible therapeusis is opened up here, the value of which experiment and experience alone will determine. The main point to be emphasized here is that the advance of science breaks down limiting traditions, and in this particular instance limiting traditions which are preserved by and imbedded in our language; for such a concept means nothing more nor less than that what is ordinarily recognized as constitution and generally thought of as unmodifiable is transferred to the category of acquired characters which can be changed by

[5] "Individuation versus Integration in the Development of Behavior."

experience. The supposedly irreversible has been found to be in fact reversible. If this is so—and I merely put it forth as a hypothesis, then surely man may look forward to untold accomplishments in the future which he has a right to expect will equal or exceed those of the past; all of which is rendered possible by the fact that he presents to the world into which he is born a concentrated solution, as it were, of the possibilities of adjustment to the environment which he has acquired through the millions of years of the past experience of life, which possibilities are ordinarily only partially and inadequately realized.

One of the characteristics of man which is exceedingly significant for this process of continuous adjustment is his very highly developed self-regard. In the old medieval universe in which he lived he was its center and all the rest of creation existed to minister to him and to emphasize his importance. When the teachings of astronomy overthrew this geocentric universe man resented it tremendously and fought these ideas vigorously until, convinced against his will, he had to accept the facts; and then, in order to compensate himself for his loss of self-esteem he began to acquire a knowledge of this universe, to master it in this way, and hence he became an astronomer. When the theory of evolution threatened man's dominance among the animals he again resented being pulled from his pedestal, but when he had to accept these facts he reacted by the compensatory mechanism of mastering this new world in which he found he had to live, and he became a biologist. When the more recent advances in the psychology of the unconscious demonstrated that each individual was just like everybody else, that we were all turned out of a common mold, that our past was of such infinitely greater significance than what we had acquired in our short lifetimes, that our personal and unique qualities were negligible, man again resented being merged with all his fellows; but when he had to accept this fact he began again to protect himself from the feeling of being at a disadvantage in this new world by mastering the facts of this new science, and he became a psychologist. In each instance when his dominance by birth and position was threatened he compensated by learning to master reality by knowledge and thus reconquered his dominion but on a different plane. And thus as time passes his possibilities constantly increase. He becomes more highly differentiated, to be sure, but the significance and the value of his differentiations are dependent upon the original source of all energy, just as the blood supply of the tiniest capillary is dependent upon the reservoir of blood in the heart. This reservoir makes him kin to the whole world and its existence expresses the fact of his capacity for accumulating unto himself, in miniature, the possibilities of his entire environment.

This thesis, of course, might be carried out to almost any conceivable lengths. The comparison of man's thinking, as it is reduced to more primitive levels, with the thinking of children and of primitive man, is full of interesting material. We see our patients definitely expressing themselves in their behavior and their language by animistic mechanisms. We are familiar with their beliefs in magic and in the supernatural, and in the more malignant types of disorder there appear strange and weird forms in the content of thought which can only be likened in their archaic characteristics to the fossils we are familiar with in the field of paleontology. Similarly, if we wish to develop our thought along the lines of what years ago Roux called his "developmental mechanics," I am sure we could find many illustrations at the organic level that would bear out what has been said. The struggles between the different parts of the organism are as real as the intrapsychic conflicts, and the principle evidently holds that the pattern of differentiation is dominated by the total pattern of the organism as expressed in such terms as Lashley has used, for instance, with regard to the central nervous system when he speaks of the equipotentiality of the brain cells, by which he means that aside from their specific functions they have certain general functions which we may conceive to have been the basis from which the specific have differentiated. All these concepts assist us to an understanding of ourselves. They enable us to appreciate the significance of the utter selfishness of the individual organism, of the aggressive tendencies which it is willing to utilize for its self-aggrandizement, and of the usually bewildering fact that an individual may hold two mutually exclusive opinions about the same question at one time without one seriously interfering with the other. We can understand, too, why, for example, we find the psychiatrist writing about such concepts as time and space,[6] which used to be considered exclusively matters for investigation by the physicist and speculation by the philosopher. And, finally, we must appreciate that the peculiar constitution of man is his key to the understanding of nature or, perhaps it were better said, to the understanding of nature as he comprehends it. All of which is perhaps not especially new or startling, but its significance, to my mind, lies in the fact that no single scientific discipline, at least in the present century, has offered so much by way of promise in the solution of these vexatious problems as psychiatry. It will remain to be seen how satisfactorily these promises will be realized in the future.

[6] Paul Schilder, *Psyche*, 14: 124, 1934.

OBITUARY

DAVID WHITE

DR. DAVID WHITE died at his home in Washington, D. C., on February 7, 1935.

Born in Palmyra Township, Wayne County, N. Y., on July 1, 1862, of early pre-Revolutionary stock, the youngest of a family of eight, he attended the country schools, prepared for college at Marion Collegiate Institute and entered Cornell with the class of 1886.

Botany was an early interest, stimulated by an inspiring teacher at Marion and maintained throughout his college career and later life. In his sophomore year he came under the influence of Samuel Gardner Williams, Charles S. Prosser and Henry S. Williams and thus acquired a sound training in general geology and paleontology. In the course of the field work of the classes in geology he made substantial collections of Devonian plant fragments in the vicinity of Ithaca. Because of his training in both systematic botany and paleontology, these fossils intrigued him and became the basis for the thesis then required for the B.S. degree at Cornell.

In the spring of 1886 Professor Lester F. Ward, in charge of paleobotanic investigations for the U. S. Geological Survey, appealed to Professor Williams for an assistant with training in paleontology and capacity for illustrative work. White, who had had some training as a draftsman and had illustrated his bachelor's thesis by new figures of much merit, was promptly recommended and as promptly invited to Washington to undertake, for the Geological Survey, the task of preparing illustrations for the use of Professor Ward. Thus began, in May, 1886, an official connection that was maintained with few interruptions until Dr. White's death, nearly 49 years later.

Ward's own interest, although very broad, was primarily in the fossil plants of the Mesozoic, and White early came to specialize in the practically unoccupied field of the Paleozoic. This field he soon made his own. His high reputation as a stratigraphic paleontologist rests primarily upon his studies of the Pottsville floras of the Appalachian province.

He revolutionized the preexisting concepts of the stratigraphic position of large portions of the Pennsylvanian section, particularly in the southern Appalachian region, and demonstrated that thousands of feet of beds in Alabama, Tennessee and Kentucky particularly, which had been regarded as much younger, were of Pottsville age. These conclusions, at variance with the positions then held by such authorities as I. C. White and J. J. Stevenson, nevertheless quickly won general acceptance, owing no doubt in large measure to the tactful, considerate and reserved but convincing way in which the young paleontologist presented his evidence.

So thorough and so detailed was White's work that he soon came to be the main dependence of the stratigraphers of the Federal and State Surveys who were working on the Pennsylvanian rocks of the Appalachian province—not only for the correlation of major divisions of the rock groups but even for the identification of individual coal beds from point to point.

It is difficult for any organization to keep its able specialists out of administrative activities, particularly if their interests are broad and their judgments sound. White suffered the usual fate and about 1907 was drawn into Survey administrative work, first as head of the Section of Eastern Coal Fields and later as chief geologist. He served in the latter capacity during the decade 1912–22. When at the end of this period, in response to his own repeated urgings, he was relieved of direct administrative responsibility, it was with the expectation that his personal research work could be immediately resumed, but there intervened a period of 3 years as chairman of the Division of Geology and Geography for the National Research Council before his desire could be realized. Meanwhile there had developed many calls upon his energies through various committee and advisory relations, formal and informal, with the National Academy of Sciences, which he served for 4 years as home secretary and for 2 years as vice-president, so that even his return to research in 1925 was, in a measure, nominal.

Early in 1931 there came a serious physical breakdown, from which a partial recovery left his mental powers entirely unimpaired, although physical endurance was diminished. The last years have been dedicated, without diminution in either enthusiasm or ability, to work on deferred problems within his selected fields. Just a few days before the end he completed a manuscript on "Metamorphism of the Organic Sediments and Derived Oils," in which his great carbon-ratio theory of a generation ago is reviewed and modernized.

To his close associates in the Geological Survey and the scientific organizations of which he was a member, Dr. White was always an inspiration. His enthusiasm and industry were unflagging, his knowledge encyclopedic. His personal and professional generosity knew no limits, and to the earnest younger student who sought his counsel he would devote time without stint, pouring out for the benefit of the neophyte a wealth of information and inspiration, of suggestion and advice, which constituted both a program for a scientific career and a guide to its attainment. Always generous in his judgments, his rare displays of impatience were reserved for the slacker or the careless and particularly for lapses in ethical standards. For these

he had no tolerance. But even his condemnations, although expressed picturesquely and with fervor, were couched in terms so humorous and so kindly as to convey the impression that their object was to be pitied rather than blamed.

He never lost hope for any man, and, indeed, within the sphere of his influence it was difficult for an associate to do less than his best, because it was so obvious that no less was expected of him.

Along his pathway through life are hundreds of fellow men and women who have been helped to bear or to forget the burdens of life by his cheerful but adamant refusal to admit that there are any. In his philosophy life consisted wholly of opportunities to be made the most of, never of limitations to mourn over. How interesting and what fun it all was, and how particularly fascinating the career of science, constantly opening as it does new vistas of comprehension and understanding! His was the quenchless spirit of the inveterate explorer, as every leader in science must be, always eager to see what lay beyond the visible horizon and tremendously pleased as the new vistas opened. He was too enthusiastically busy to waste time on anything so fruitless as introspection. Given neither to underappreciation nor to overappreciation of self, he was wholesomely lacking in self-consciousness and always looked outward and forward, never inward or back. There was no resisting the infectiousness of his spirit.

Both by the example of his own great and sound accomplishments and by his eagerness to see others attack the innumerable problems awaiting solution, he became an inspiration and a power in his generation.

His was a proud spirit, but proud of simplicity, proud of integrity, proud of genuineness and independence and tolerance, never of place or power or trappings; and proud of reputation only as evidence that his own well-based but unassertive self-respect found support in the opinions of men.

Despite an openness of character really possible only to those who have nothing to conceal, there were things about which he was disingenuous. No one will ever know how many he has aided with funds—not easily, as the wealthy can, but only by the exercise of a generosity that was real because it meant personal sacrifice. Still less will we know about the hundreds of younger associates whom he has counseled and encouraged and in whose way he has placed opportunities at the price of a limitless outpouring of his own energies.

Like many geologists of his generation, Dr. White did not lack opportunities to capitalize his abilities and his unique knowledge. Although he never sought them, offers came to him to enter the commercial field at several times the modest salary which the government pays its scientific leaders. These offers never tempted him. Although he realized that there are men of vision in the modern industrial world who know that an untrammeled research staff is a wise investment, even measured by the profit standards that determine success or failure in business, he yet was unwilling to enter an environment motivated by profit as a main objective. Although some of his own work had great economic significance, that was incidental to his research, and he preferred it so. The choice lay between applying his talents at a large salary, primarily to profits for a restricted group, with research as an incidental by-product, and applying them broadly, at a small salary, to the general service of mankind, with the economic results incidental. There was never any hesitation on his part about the choice to be made. He remained a government geologist until the end.

As a geologist, Dr. White is to be judged not of course primarily by the length of his bibliography, which may contain 200 titles, but by the diversity of the fields that he occupied and in which he wrote with authority. He has long been the foremost Paleozoic paleobotanist on this continent and perhaps in the world. His work in this field was not merely soundly systematic and descriptive but was interpretative from the beginning. He was a stratigraphic paleontologist of the highest rank. He was our foremost authority on the origin and evolution of coal. His great generalization, known widely as the carbon-ratio theory, was an outgrowth of his studies on the origin and evolution of both coal and petroleum. It established a "dead line" beyond which oil pools will not be found and thus has great economic significance. It alone stamps him as a rare original investigator and thinker. He contributed significantly in the field of isostasy, and during the world war he administered an important unit of government in such fashion as to make it most useful in the crisis.

Happily Dr. White received during his lifetime gratifying recognition of the high place that he held in the esteem of his fellows. He became vice-president of the National Academy of Sciences after long service as its home secretary. He was president of the Geological Society of America. Three of our leading universities honored him with doctorates. Two of the principal medals of the National Academy were bestowed upon him. He received the Penrose Medal of the Society of Economic Geologists and the Boverton Redwood Medal of the Institute of Petroleum Technologists of London. He was an honorary member of the geological societies of Belgium and China.

Thus his years were as full of honors as were his days of activity. His was a career that came to full

and happy fruition. His last day was a busy and a cheerful one. Before the dawn of the next he went quietly to sleep.

W. C. MENDENHALL

RECENT DEATHS

DWIGHT PORTER, emeritus professor of hydraulic engineering at the Massachusetts Institute of Technology, died on February 26. He was in his eightieth year.

WILLIAM HALE HERRICK, retired professor of chemistry at Pennsylvania State College, died on February 26. He was eighty-five years old.

DR. CLEOPHAS C. O'HARRA, professor of geology and president of the South Dakota State School of Mines, died on February 21, at sixty-eight years of age.

HENRY EDISON PHELPS, research engineer with the American Telephone and Telegraph Company from 1917 to 1934 and with the Bell Telephone Laboratories since March, 1934, died on February 21, at the age of forty-one years.

DR. HERBERT A. PULLEN, past president of the American Society of Orthodontists and a former dean of the University of Buffalo, died on February 17.

DR. ARTHUR THOMSON, emeritus Dr. Lees professor of anatomy at the University of Oxford, died on February 7 at the age of seventy-six years. He was distinguished for his work as an anatomist and as a physical anthropologist.

PROFESSOR WALTHER SPIELMEYER, chief of the division of neuropathology in the Forschungsanstalt für Psychiatrie in Munich, died on February 8.

SCIENTIFIC EVENTS

THE THREE HUNDREDTH ANNIVERSARY OF THE FOUNDING OF CHEMICAL INDUSTRIES IN AMERICA

APPOINTMENT by the Manufacturing Chemists Association of a committee to cooperate with the American Chemical Society in celebrating in New York during the week of April 22 the three hundredth anniversary of the founding of the chemical industries in America has been announced.

The members are: E. M. Allen, president of the Mathieson Alkali Works; Lammot du Pont, president of E. I. du Pont de Nemours and Company, and George W. Merck, president of Merck and Company.

Science and industry will join in an exposition of chemistry's development since John Winthrop, Jr., first colonial governor of Connecticut, in 1635 mapped out a far-reaching program for the production of salt, iron, glass, potash, tar, black lead, saltpeter, medicines, copper, alum and other chemicals.

Dr. Arthur W. Hixson, professor of chemistry at Columbia University and chairman of the general committee of arrangements, reports that at the tercentenary assembly, to be attended by more than 10,000 representatives of chemistry and allied sciences, Winthrop will be heralded as the real founder of the nation's chemical industries.

Inventions, discoveries and explorations in chemistry over the span of 300 years will be traced to show how infant industries have become the bulwark of national defense, the basis of modern industrial progress and the source of a large and growing percentage of national wealth.

Senator Pat Harrison of Mississippi and Representative James W. Wadsworth of New York will be among the speakers at a dinner meeting on Wednesday evening, April 24. On the same day a chemical industries symposium, planned to interpret the close relationship between the chemical industries and the national welfare, will be held. Thomas Midgley, vice-president of the Ethyl Gasoline Corporation, will deliver an address on "Chemical Developments in the Next One Hundred Years." William B. Bell, chairman of the board of directors of the American Cyanamid Company, will speak on "National Planning and the Chemical Industries."

Other themes at this symposium include: "What the American Chemical Industries Have Done and Are Doing for the Nation"; "New Foreign Problems Confronting the American Chemical Industries"; "Scientific Foundations of the American Chemical Industries."

On Thursday, April 25, there will be a symposium on the economic problems of the chemical industry, with R. P. Soule, chemical economist of the Tri-Continental Corporation, as chairman. "Machine Age or Material Age?" is one of the topics to be discussed.

The rise of the process industries in the post-war decade will be described, the discussion centering around synthetic fuels, building materials, rubber wrappings; the encroachment upon agriculture and the products of the farm; the realignment of industries and the outlook for the future.

Depreciation and obsolescence charges under the New Deal will be another theme of this symposium. The chemical industry, according to the announcement, is outstanding in high charges for depreciation and obsolescence. The chemists will discuss federal policy toward reducing corporate surpluses and increasing tax revenues, and will explain their attitude

toward current and past depreciation and obsolescence reserves.

The question of chemical prices will also come up, the discussion involving the trend of typical prices against the background of the general price structure, below both 1914 and 1926 levels. A protective tariff, according to the announcement, has not increased prices, low prices resulting in spite of high wages. Other problems to be dealt with include prices *vs.* earnings, trend of prices in the future, elastic and inelastic markets for chemicals.

A third symposium will be devoted to materials of construction in the building industry. The chairman will be Professor James R. Withrow, of the Ohio State University. A group of papers will outline the latest developments in new materials of construction important to the chemical industries. These papers will cover a wide range of materials, including metals, ceramics, plastics, rubber and alloys.

Sessions are scheduled by the nineteen professional divisions of the American Chemical Society. On Tuesday evening, April 23, the William H. Nichols Medal of the New York Section of the American Chemical Society will be bestowed upon Father Julius A. Nieuwland, of Notre Dame University.

Numerous allied organizations, industrial and scientific, are aiding in the plans for the tercentenary events. Among them are the Synthetic Organic Chemical Manufacturers Association and the chemical societies of the metropolitan district.

THE BANTING RESEARCH FOUNDATION

THE work carried out under grants from the Banting Research Foundation during the past year is reported by the secretary to have been very satisfactory. Further, during the year reports and printed papers have been received from workers whose grants terminated during the year 1932–33. As a result, the secretary is able to report that 20 papers have been published during the past year and several are in preparation or have been submitted for publication. The number of printed papers would have been increased had not the depression led editors of scientific journals to refuse three or four papers on account of their length, or the necessity of a larger number of illustrations than their funds allowed them to accept. This difficulty has shown itself most acutely in regard to the grants made for the study of the racial factor in labor by Dr. Cates, representing the committee in charge, and Dr. Goodwin. One paper in this series has now been accepted and there is hope that others will also appear during the next year.

Papers published during the year include that of Dr. A. C. Abbott, of the University of Manitoba, whose paper on constriction of the trachea confirms and extends the work of Breitner and others on the effect of oxygen restriction on the thyroid gland; that of Dr. J. Beattie and P. R. MacDonald, of McGill University, which forms an important contribution to the physiology of the lachrymal gland; Dr. Maurice Brodie, of McGill University, whose seven papers on infantile paralysis led up to his work on treatment, which is attracting wide-spread interest; Dr. A. M. Davidson, of the University of Manitoba, in five communications on fungus diseases of the skin, contributed much to our knowledge of these diseases, their animal hosts and their treatment. Dr. R. D. H. Heard and Dr. A. D. Welch, of the University of Toronto, showed that ascorbic acid was the substance which prevented the oxidation of epinephrine in adrenal perfusates. This work also opened up a field of study in the oxidation reduction changes in the body, which had not been previously explained. Dr. R. F. Shaner, of the University of Alberta, published two interesting studies of the embryological development of the eighth nerve nuclei. Miss Armine Alley, of McGill University, published three papers dealing with the mechanism of gastric secretion and with the treatment of hyperacidity.

The grant made annually under the second clause of the foundation's charter to Sir Frederick Banting for the working of the department of medical research of the University of Toronto, was also productive of much valuable work and some thirteen papers. Several of these dealt with the biochemistry of silica in the body, others with the phospholipids and glycerophosphates, their enzymic hydrolysis and the type of phosphoric esters in malignant tissues. To these studies Dr. E. J. King, M. E. Dolan, H. Stantial, A. R. Armstrong, J. J. Rae, J. Fallon, D. A. Irwin and E. L. Outhouse contributed, while H. J. Perkin contributed a paper on the determination of iodine in the blood.

THE ROTHSCHILD COLLECTION OF BIRDS AT THE AMERICAN MUSEUM OF NATURAL HISTORY

THE Rothschild or Tring collection of birds is now being prepared for classification and exhibition at the American Museum of Natural History under the supervision of Dr. Ernst Mayr, associate curator of birds. It was acquired from Lord Rothschild in London in 1932 and was presented to the museum in memory of Harry Payne Whitney by his family, but was never unpacked because of inadequate facilities for storage and display. However, the Whitney Wing, made possible by a gift of $750,000 from Mr. Whitney in 1929 and matched under the terms of the gift by an equal sum from the city of New York, has recently been completed, and in this wing part of the collection will be exhibited, while part will be stored in 52,000 drawers as a study collection. The collec-

tion, probably the most important and the largest private collection in the world, contains about 280,000 specimens, including 55,000 birds of North and South America and 25,000 sea birds.

According to the *New York Herald Tribune,* Dr. Robert C. Murphy, curator of oceanic birds at the museum, who supervised the sorting, indexing and packing of the birds in England, states that by the acquisition of the Tring collection there are added to the museum collection birds of Europe, Asia and Africa, the Indo-Malayan and Melanesian districts, Australia and New Zealand, a large proportion of extinct species from many localities and many very valuable hybrids and aberrant forms of numerous families, in which Lord Rothschild always took a special interest.

The Tring collection contains many genera not, up to the present, represented in the American Museum; it gives also a relative wealth of species, known heretofore only from unique specimens. Types—specimens, that is, the particular skins on which the original description of species or races are based and which therefore serve as the standard of comparison—number about 3,000. Among the rarities are a great auk, two Labrador ducks, and a series of passenger pigeons and Guadalupe caracaras. More important scientifically than these, however, are the remarkable aggregation of birds of paradise, including all but four or five of the known species as well as several extraordinary hybrid forms, collections of Hawaiian honey-creepers and Old World sunbirds and the 6,000 American humming birds.

Aside from the rarities, historic specimens and birds of gorgeous plumage, the greatest resources that the Tring collection offers to ornithology in America lie in the series of entire Old World families and lesser groups, which, by comparison with American groups, impart new meaning to the subjects of evolution and geographical distribution. It is invaluable from a taxonomic standpoint.

THE ANNUAL MEETING OF THE AMERICAN PHARMACEUTICAL ASSOCIATION

THE American Pharmaceutical Association and affiliated organizations will meet in Portland, Oregon, from August 5 to 10, with the Hotel Multnomah as headquarters. The North Pacific Branch of the association will have direct charge of arrangements for the meeting under the supervision of the local secretary, Dean A. O. Mickelsen, of the North Pacific College of Pharmacy, Portland, and with the active cooperation of committees representing the pharmacists of Oregon, Washington, Idaho, California and Montana. This is the first time that the association has met in this section and every effort is being exerted to make it an outstanding event.

The Pharmaceutical Associations of Oregon, Washington and Idaho will hold their annual meetings, jointly, in Portland on Monday and Tuesday, August 5 and 6. The Plant Science Seminar and the National Conference on Pharmaceutical Research will hold their annual meetings during the previous week, the latter on Saturday, August 3. The National Association Boards of Pharmacy and the American Association of Colleges of Pharmacy will hold their annual meetings, as usual, on Monday and Tuesday, August 5 and 6.

The sessions of the American Pharmaceutical Association, including those of the Conference of Pharmaceutical Association Secretaries and of the Conference of Pharmaceutical Law Enforcement Officials, will be held on Wednesday, Thursday and Friday, closing on Friday evening.

A joint banquet for all groups, including those attending the state association meetings, is scheduled for Tuesday evening, August 6. On Saturday, all visitors will be taken on an all-day trip by bus, over the Columbia River Highway, during which an outdoor luncheon will be served. Other entertainment features will be scheduled during the week and every opportunity will be provided to see the many unusual points of interest. The arrangements for the various business sessions and the entertainment features will be announced as they are completed.

The American Chemical Society will hold its summer meeting in San Francisco during the week of August 19, which will be convenient for those who wish to attend both meetings.

Portland has ample hotel facilities for the convention. The Hotel Multnomah will be given over to the business sessions and entertainment of the delegates and visitors to the American Pharmaceutical Association and related organizations. The headquarters of the state associations will be located in other hotels within easy access to the Multnomah, so that visiting will be easy.

The committee on transportation of the American Pharmaceutical Association will soon make an announcement in reference to rates and time. The certificate plan will not be necessary because of the unusually low round-trip or single rates, including choice of routes and full stop-over privileges. Special train accommodations will be offered from Chicago and other points, and a variety of interesting side-trips will be available.

THE ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF PHYSICAL ANTHROPOLOGISTS

THE annual meeting of the American Association of Physical Anthropologists will be held at the Wistar Institute of Anatomy and Biology, Philadelphia,

from April 25 to 27, with headquarters at the Bellevue Stratford Hotel.

The tentative program is as follows: On April 25, the afternoon session will be devoted to the reading of papers and the first business session, including reports of officers and standing committees and the introduction of new business; in the evening there will be a public address on a topic of general interest; on April 26, the morning session will be given over to the reading of papers, and in the afternoon the report of the committee on the international standardization of anthropometric methods, of which Dr. Aleš Hrdlička is chairman, will be presented and discussed. There will also be a discussion by Dr. Raymond Pearl on biometric methods in anthropology; in the evening, the annual dinner will be held, with Dr. Milton J. Greenman, director of the Wistar Institute, as toastmaster; on April 27, there will be reading of papers at both sessions and the final business session will occur. Members of the association will be guests of the Wistar Institute at lunch on April 26 and 27.

Members who wish to present papers at this meeting should notify Dr. Raymond Pearl, 1901 East Madison St., Baltimore, Md., as soon as possible, giving name and institution, title of paper, time required for presentation, whether or not it is to be given with lantern slides, charts or other illustrations, and a non-technical summary of not more than 500 words. Those offering more than one paper should indicate which they prefer to present in case the program is crowded and which may be read by title. The complete program will be announced early in April.

SCIENTIFIC NOTES AND NEWS

DR. CHARLES SIDNEY BURWELL, professor of medicine at the Vanderbilt University School of Medicine, has been appointed dean of the faculty of medicine and research professor of clinical medicine at the Harvard Medical School to succeed Dr. David L. Edsall, who announced his retirement two months ago. The appointment becomes effective in September. Dr. Cecil Kent Drinker, professor of physiology and acting dean, has been appointed dean of the School of Public Health in succession to Dean Edsall.

THE medal founded by the Wilhelm Roux Steftung für Entwicklungsmechanik, in commemoration of Wilhelm Roux, who died in 1924, has been awarded to Dr. Jan Boeke, professor of histology in the University of Utrecht, for his research work on the development of the nervous system.

THE council of the Institution of Naval Architects has awarded the Gold Medal for the year 1934 to Vice-Admiral Y. Hiraga, professor of naval architecture and applied mechanics in the University of Tokyo, for his paper on "Experimental Investigations on the Resistance of Long Planks and Ships," and the premium to Professor B. P. Haigh, of the Royal Naval College, Greenwich, for his paper on "Further Tests and Result of Experiments on Electrically Welded Joints in Ship Construction." According to *Nature*, the medal and premium will be presented at the opening of the annual general meetings on Wednesday, April 10, at the Royal Society of Arts in London.

THE Chadwick Gold Medal and Prize of £100 was presented on February 18 to Colonel W. P. MacArthur, deputy director-general of the army medical services at the British War Office and formerly consulting physician to the British army. This award may be made once in five years to the medical officer of the British navy, army or air force who has most distinguished himself during that period in promoting the health of the men of the service to which he belongs.

PROFESSOR STEPHEN TIMOSHENKO, of the engineering mechanics department at the University of Michigan, has been appointed Hitchcock professor at the University of California.

DR. C. LADD PROSSER, research associate in physiology at Clark University, has been appointed assistant professor of physiology.

LESLIE WHEELER, a member of the board of trustees of the Field Museum of Natural History, has joined the scientific staff of the museum as associate in ornithology. He has been assigned facilities for active research work in connection with the collections of birds of prey.

DR. MATARO NAGAYO, professor of pathology and dean of the medical faculty, has been made president of Tokyo Imperial University.

DR. FERNANDO OCARANZA, director of the faculty of medicine at the University of Mexico, has been appointed president of the university.

THE board of management of the London School of Hygiene and Tropical Medicine of the University of London has appointed Sir Cooper Perry to be its chairman for the current year.

DR. L. RUZICKA, professor of chemistry at the Technische Hochschule, Zurich, Switzerland, will be a visiting professor in the department of chemistry

at the University of Chicago during the summer quarter of 1935. Professor Ruzicka will give two series of lectures, one on "Special Topics in the Chemistry of Alicyclic Compounds and the Terpenes," the other on "Selected Topics of Biochemistry."

DR. SIMON FLEXNER, director of the Rockefeller Institute for Medical Research, returned on February 25 from a visit to Egypt.

DR. HARRY L. SHAPIRO, associate curator of physical anthropology at the American Museum of Natural History, returned on February 26 after spending four months with the Templeton Crocker expedition to the South Seas, during which he made a population study in the Marquesas and racial studies on Pitcairn and Easter Islands.

DR. EMIL F. GUBA, assistant research professor of botany at the Massachusetts State College, has been granted a six months' leave of absence, to become effective on April 1. Dr. Guba, who is stationed at the Waltham field station, plans to spend most of his leave studying and writing a monograph at Harvard University.

DR. STEPHEN JAROSZ, of the geographical institute of the Jagiello University in Krakow, Poland, will begin early in March a study of the geography, botany and forestry of four islands near the coast of Alaska.

DR. GEORGE C. BRANNER, state geologist for Arkansas, has been elected president and Dr. Arthur Bevan, state geologist for Virginia, secretary of the Association of American State Geologists for 1935. Dr. Raymond C. Moore, state geologist for Kansas and professor of geology and paleontology at the University of Kansas, has been made a member of the executive committee.

THE Eastern States Archaeological Association held its annual meeting on February 23 at the Rochester Museum of Arts and Sciences, with the president, Colonel L. M. Pearsall, presiding. Arthur C. Parker, William C. Ritchie and others of the Rochester Museum staff read a series of papers on the field work of the museum's recent excavations at Alima and Canandaigua.

A JOINT meeting of the Society of Chemical Industry, the American Chemical Society, the Electrochemical Society and the Société de Chimie Industrielle was held on March 8 at the Chemists' Club, New York. A paper on "The Combustion of Coal as a Problem in Chemical Engineering" was given by Stephen P. Burke, director of the industrial science division of West Virginia University.

THE results of research in dentistry during the past year were described before the Baltimore section of the International Association for Dental Research on February 27. Dr. E. V. McCollum, of the School of Hygiene and Public Health of the Johns Hopkins University, presided.

AT the annual general meeting of the Royal Astronomical Society, held on February 8, the following officers were elected: *President,* J. H. Reynolds; *Vice-Presidents,* Professor S. Chapman, Dr. H. Spencer Jones, Dr. H. Knox-Shaw, Professor F. J. M. Stratton; *Treasurer,* Sir Frank W. Dyson; *Secretaries,* W. M. H. Greaves and Dr. W. M. Smart; *Foreign Secretary,* Professor Alfred Fowler.

DR. JAMES R. ANGELL, president of Yale University, recently gave the Elihu Root lecture of the Carnegie Institution of Washington. His subject was "Popular and Unpopular Science."

DR. JOEL H. HILDEBRAND, professor of chemistry at the University of California, spoke on "Solubility" at the dinner meeting of the southern section of the American Chemical Society in Los Angeles on March 1.

THE twelfth Sedgwick Memorial Lecture was given on January 25 at the Massachusetts Institute of Technology by Dr. J. B. S. Haldane, professor of genetics at the University of London and head of genetical research at the John Innes Horticultural Institution, who spoke on "Some Problems of Mathematical Biology."

LECTURES under the auspices of the American Entomological Society and the Philadelphia Microscopical Society were given at the Academy of Natural Sciences of Philadelphia on February 28 by Dr. W. Dwight Pierce, a member of the academy staff, and Dr. David H. Wenrich, professor of zoology at the University of Pennsylvania, on the transmission of human diseases by insects.

THE University of Rochester held its fourth annual Sigma Xi day on February 22, with Dr. George Boas, professor of philosophy at the Johns Hopkins University, as the principal speaker. His subject was "Science and Metaphor." A morning science lecture for young people on "Corals and Cannibals" was given by Dr. J. Edward Hoffmeister, professor of geology at the University of Rochester. During the afternoon a series of lecture-demonstrations was given by Dr. Joseph L. Boon, of the Eastman Kodak Company, Dr. Bradford Noyes, of the Taylor Instrument Companies, and Drs. G. P. Berry, I. A. DuBridge, H. C. Hodge and E. O. Wiig, of the University of Rochester.

DR. ALEXANDER SILVERMAN, head of the department of chemistry at the University of Pittsburgh, will lecture before the southern sections of the Ameri-

can Chemical Society on "Glass: An Indispensable Factor in Modern Civilization." The schedule follows: March 19, Lexington section, Lexington, Kentucky; March 20, East Tennessee section, Knoxville; March 22, Georgia section, and Georgia Academy of Sciences, Atlanta; March 23, Alabama section, Birmingham; March 25, Louisiana section, New Orleans; March 27, Florida section, De Land; March 30, Virginia section and Hampton Roads Chemists Club at the College of William and Mary, Williamsburg.

ON January 19 Dr. W. F. G. Swann, director of the Bartol Research Foundation, delivered an address before the Ohio State chapter of the Society of the Sigma Xi on the subject "Nuclear Phenomena and Cosmic Rays." This was the first of a series of lectures being sponsored by Sigma Xi at Ohio State University on the general subject, "The Nucleus of the Atom and Its Structure"; Professor M. L. Pool, Ohio State University, on February 28 spoke on "Methods, Energies and Products Involved in Nuclear Disintegration and Synthesis." The remaining lectures in the series with their dates are as follows: March 28, Professor H. L. Johnston, of the Ohio State University, "Deuterium as a Tool for Research in the Physical and Biological Sciences"; April 30, Professor E. O. Lawrence, of the University of California, "Artificial Radioactivity"; May 10, Professor G. Gamow, visiting professor at the George Washington University, "Nuclear Transformations and the Origin of the Chemical Elements."

DR. R. COURANT, visiting professor from Germany, who is now at New York University, was the speaker at the meeting of the mathematics section of the New York Society for the Experimental Study of Education at Columbia University on March 2. His topic was "The Teaching of Mathematics and Physics."

THE committee on scientific research of the American Medical Association on February 17 awarded grants to Dr. Phillips Thygeson, assistant professor of ophthalmology at the State University of Iowa, for the study of trachoma and inclusion virus disease of the genito-urinary tract; to Dr. W. J. Nungester, assistant professor of bacteriology at Northwestern University Medical School, for a continuation of studies on experimental lobar pneumonia; to Dr. Willard O. Thompson, assistant clinical professor of medicine, Rush Medical College, University of Chicago, for research on the effect of enzymatic digestion on desiccated thyroid; and to Dr. Royall M. Calder for research on the mechanism of inflammation in pneumococcus infections.

A METAL industries exhibition will be held in the Commercial Museum, Osaka, Japan, from May 10 to 31 under the joint auspices of the *Journal of Metals* and the *Daily Industrial News*.

A DAVID ANDERSON-BERRY Gold Medal, together with a sum of money amounting to about £100, will be awarded in July, 1935, by the Royal Society of Edinburgh to the person who, in the opinion of the council, has recently produced the best work on the nature of x-rays in their therapeutic effect on human diseases. A similar award will be made every three years.

THE twenty-third annual meeting of the Eugenics Research Association will be held at the American Museum of Natural History, New York, N. Y., on Saturday, June 1. All persons who have papers to present should indicate their intentions by letter as soon as possible, and the paper itself, with a 250 word abstract, should be forwarded to the secretary of the Eugenics Research Association, Cold Spring Harbor, Long Island, New York, not later than May 10. Papers will be limited to twenty minutes and must be presented in person. Lantern, blackboard, chart-wall and exhibit-space will be provided at the meeting.

THE United States Civil Service Commission has announced open competitive examinations for the positions of junior physicist, chemist, senior, associate and assistant chemists. The entrance salary for junior physicist is $2,000 per year, subject to the usual deductions; for chemists, $2,600 to $4,600. Optional subjects for the examination in physics are electricity, heat, mechanics and optics. Vacancies for chemists exist in the Food and Drug Administration, Department of Agriculture, Dental Alloy Laboratory, National Bureau of Standards and Department of Commerce. All applications must be on file with the commission at Washington not later than April 8.

THE American Association of Anatomists has been requested by the Anatomical Society of Great Britain and Ireland to consider at this time, with a view to international agreement, a revision of the standard terminology of human gross anatomy (the BNA), which has been in use in American text-books since its original adoption in 1895. For this purpose a committee has been appointed, under the chairmanship of Dr. C. M. Jackson, professor and director of the department of anatomy at the University of Minnesota. The committee has undertaken a general consideration of the problem and is studying both the British proposal and another suggested revision prepared by a committee of the German Anatomische Gesellschaft. For the benefit of those interested in solution of the problems involved in revising anatomical nomenclature, a triple list of the BNA and the British and German revisions, in parallel, has been

prepared. A limited number of copies are available for general distribution, and may be obtained without charge from the Secretary of the American Association of Anatomists, Professor George W. Corner, The University of Rochester School of Medicine and Dentistry, Rochester, N. Y.

DISCUSSION

COAL AND NATURAL OIL IN THE PITTSBURGH REGION

ATTENTION should perhaps be called to a statement in an article by Dr. Berl, entitled "The Origin of Natural Oil,"[1] in which the author says: "The presence of bituminous coal and oil in the same localities, but in different strata, for instance near Pittsburgh, forces one to the point of view that both substances were formed from the same material."

The horizons in which coal and oil, respectively, are found in the Pittsburgh region are so far removed from each other geologically that their geographical agreement must be viewed as irrelevant in any discussion of their origin.

The various coal seams lie in the Lower and Upper Coal Measures (Pennsylvanian), and the Upper Barren Series (Permian), whereas the oil-bearing sands are in the Subcarboniferous (Mississippian), and the Upper Devonian. The conditions under which the material of the coal beds accumulated, the origin of which is obvious, were very different from those which prevailed throughout the Upper Devonian and Mississippian, in the Pittsburgh region. There is total absence of evidence of swamps, such as contributed material for the coal seams, in the deeper-lying strata where natural oil is stored.

Whatever may have been the origin of natural oil, the fact that oil and coal happen to occur in the latitude and longitude of the Pittsburgh region has no bearing on the question.

EDWIN LINTON

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DISTRIBUTION OF PAPERS IN BIOLOGICAL SCIENCES FOR THE PAST EIGHT YEARS

THE summaries of researches in biology that appear in *Biological Abstracts* make it possible to determine fairly well the degree of research activity in various divisions of biology. While the editors of *Biological Abstracts* warn that it is not yet possible to cover all biological research papers published the world over and that a group of journals known to contain biological research can not yet, for one reason or another, be covered, this probably does not substantially affect the numerical relations between the various subjects discussed below.

My class in theoretic biology was assigned the job of determining the number of papers reviewed in *Biological Abstracts* during the entire period of its publication since 1927, *i.e.*, about eight years. The total number enumerated by us was 169,744. Of all the categories of papers classified in the table of contents we chose twenty-two groups. We did omit a few sorts of papers. We listed in one group all papers concerning animal physiology which is made up of twenty sub-groups. We similarly combined sub-groups of papers having to do with economic entomology and treated others likewise. We combined plant and animal paleontology into one group. This last named grouping might be criticized because the reviews in paleozoology in the *Abstracts* are general papers only, since systematic and morphological papers appear elsewhere.

We determined the number of papers in each of the twenty-two groups; found the total for each year, and then the percentage of each group of the total for that year. We then charted the variation in numbers of papers in each group for the entire eight years, but the results of this charting are not presented at this time. We also averaged the percentages of each group for the entire eight years. The results of this computation are graphically represented in Fig. 1, which also includes the percentage averages just referred to.

It should be remembered that, due to at present unavoidable difficulties, abstracts of papers are published a number of months after original publication. Systematic zoology holds first place in numbers of papers abstracted and indicates greatest activity, the total being about 38,000. Thus one of the oldest and most fundamental of biological sciences is still very much alive. Next in degree of activity is animal physiology. Nearly half of all papers reviewed are more or less directly related to the well-being of man. These groups are animal physiology, animal pathology, bacteriology, economic entomology, immunology and pharmacology. May this be interpreted as indicative of the practical tendency of pure science?

We did not attempt to weight the scientific value or importance of the papers, since we did not consider ourselves wise enough to do so. After all, would it be possible to appoint a board of judges who would give a worth-while verdict as to the relative value of this or that investigation? Would an endocrinologist regard work in systematic botany as important as his own? Some might view investigations in physiology that would reduce the mortality of babies as of great value. Others, thinking of difficulties that await the same babies when grown to adult life, might

[1] SCIENCE, 81: 2088, 18, January 4, 1935.

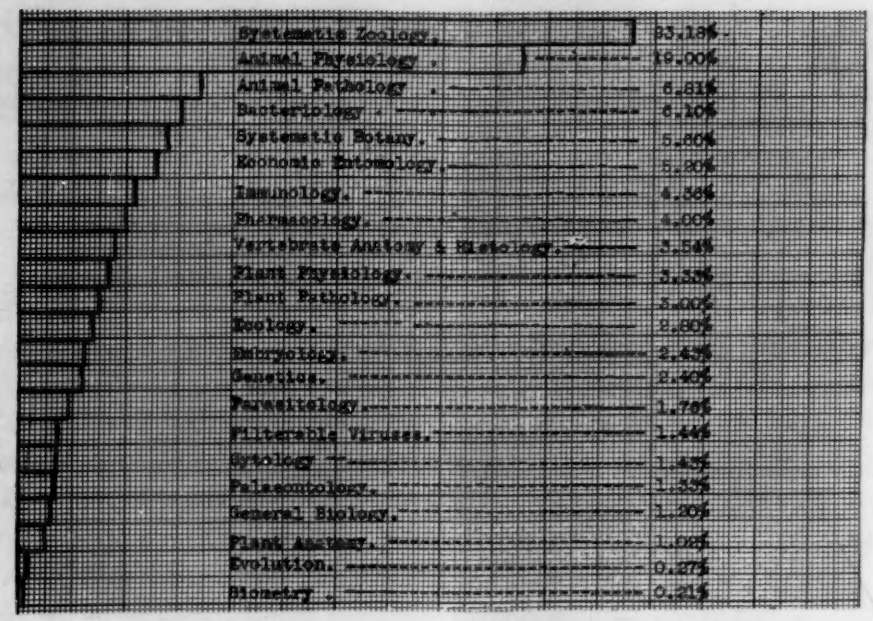

FIG. 1. Distribution of papers reviewed in *Biological Abstracts* from Vol. 1, 1927, through Oct., 1934, Vol. VIII.

regard the same investigations in an entirely different light.

And what about evolution? Papers dealing exclusively with evolution are surprisingly few. This situation may possibly cheer up the fundamentalists—or are there fundamentalists to-day? It *is* true that certain papers in experimental genetics and taxonomy discuss aspects of evolution which is not their main purpose. Is it not a fair conclusion to state that although biologists do not at all regard the evolution problem as solved, yet they evidently are not much interested in it? Is it because working in physiological fields "pans out" better?

Biometry appears to be in a state of real *depression!* According to our determinations, biometry occupies last place. At about the beginning of the present century there was great enthusiasm for biometry as a tool for measuring evolution. *Biological Abstracts* covers five or six journals devoted wholly to biometry of statistical methods but does not attempt to include many others, as for example those in which actuarial material is dominant. Nor do we find reviews of statistical papers which purport to demonstrate expectations of rise in stock values!

It must be exceedingly difficult to classify in existing categories some types of papers. Whether we wish to call it evolution or not, there is constant change in *styles* of investigations. For example, there is a place for papers in embryology and a place for papers in physiology. But at present there is considerable activity in the physiology of developmental phases. Difficulty in assigning papers such as these will continue because the biological sciences constitute a growing and changing body of knowledge.

Finally, it might not be amiss to acknowledge the debt biologists owe to *Biological Abstracts,* a truly democratic enterprise of the Union of Biological Societies. Its value will tend to increase in geometrical ratio as the years of its publication accumulate.

GEO. G. SCOTT
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LABUAN, BORNEO, A NEW LOCALITY FOR THE WHALE SHARK

ON March 29, 1934, while working at the office of Dr. W. Birtwistle, director of fisheries for the Straits Settlements and Federated Malay States, at Singapore, the captain of a coasting vessel came in for information. He had with him the picture and dimensions of a very large fish which he had seen at Labuan a few days before. No one there knew the fish, but I recognized it at once as a fine typical example of *Rhineodon typus,* the whale shark. The specimen was 25 feet long.

Labuan is a small island on the northwest coast of Borneo, and gives us a new locality in plotting the distribution of this great fish. I had previously recorded the occurrence of the whale shark at Darvel Bay, on the northeast coast of British North Borneo, and had predicted its occurrence along the coast of the whole northern half of Borneo. The Sulu Sea is evidently one of the favorite haunts of this enormous fish, for we now have many records of its occurrence in all parts of the Philippines contiguous to the Sulu Sea. These records go back over a hundred years. Since the shores of North Borneo are laved by the Sulu Sea we may look for the whale shark anywhere in that region.

I have no doubt that Rhineodon is equally common in the Celebes Sea, which is connected by broad deep passages with the Sulu Sea. It may therefore be expected all along the north coast of Celebes and eastward along the north shore of New Guinea. Young whale sharks, up to a length of ten meters,

blunder into narrow straits and inlets and explore bays where they readily fall victim to the intricacies of the native baklad or fish corrals. Inquiry among the Malay fishermen often reveals the capture of whale sharks in fish corrals at various times in the memory of the older men.

ALBERT W. C. T. HERRE
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SCIENTIFIC BOOKS

PARENTHOOD

The Twilight of Parenthood. By ENID CHARLES. W. W. Norton and Company, New York. Pp. vi + 226. $2.50.

THERE have been three main periods in the history of opinion on population problems. In the first there was general and somewhat naive agreement with the Psalmist that children are like arrows in the hand of a giant, happy is the man who has his quiver full of them—in short, that increase in population is always desirable. In 1798 Malthus ushered in the second period by pointing out that the potential reproductive capacity of mankind is quite capable of outrunning the means of subsistence, and for more than a century afterwards the dominant note among writers on the subject was the fear that overpopulation would reduce mankind to misery. It is true that since about 1870 the birth rate in most European countries has been declining, but as the death rate also declined population kept on increasing and the era at which it would outrun the means of subsistence seemed merely deferred. In 1925, however, Dublin and Lotka pointed out that a decline in the birth rate results in a larger proportion of women in the child-bearing ages than in a stable age distribution and that consequently if the decline in the specific birth rates at ages were arrested the crude birth rate would continue to decline until the stable age distribution was reached. On the other hand, with constant death rates at ages the crude death rate would increase, so that a population which was actually increasing would ultimately with the same specific birth and death rates become stationary or even decrease. The United States, they found, was close to this potentially stationary condition in 1920, and Kuczynski has since shown that a number of European countries have reached a state of potential population decrease. The dominant note is no longer fear of overpopulation but rather of population decrease and the impression left on the mind of the reader by some of the more fervid authors is that unless something is done about it mankind will become extinct not later than next Tuesday.

Dr. Charles begins her book with an account of the improvements in agricultural science which have increased the means of subsistence. The second chapter, which gives a simple explanation of the methods of demographic statistics, leaves rather the impression that the newer methods are due almost entirely to Kuczynski. As a matter of fact the net reproduction rate was first used by Boeckh, while the development of the mathematical analysis of the dynamics of population is mainly due to Lotka. The decline in the birth rate and the differential fertility of social classes are next discussed and it is pointed out that if, as there is some reason to believe, the birth rates of the poorer classes, who form the larger part of the population, are approaching those of the wealthier classes, the birth rate of the whole population will decline still further.

The fifth chapter is devoted to a discussion of whether the observed decline in the birth rate is the result of increase in density of population, as Pearl has concluded, or of some special cause such as the spread of contraception. It is scarcely correct to say that "Pearl himself was unable to offer any explanation of the fall in fertility observed in Drosophila." The latter[1] has found evidence "that crowding produces the observed effect on rate of egg laying primarily, though probably not solely, as a result of a collision or interference action of the flies upon each other, which alters the normal physiological equilibrium and processes of the individual, particularly with reference to three major functions—food intake, energy output in muscular activity and oviposition." Nor is the observed inverse relation between density and fertility confined to *Drosophila*. It has also been observed in the flour beetle *Tribolium* over the greater part of the density range, in fowls and in human populations.

The last chapter deals with changes in social organization which may make parents willing to have more children. The system of family allowances, Dr. Charles points out, has had little influence on the birth rate in either France or Australia, where it has been tried on a large scale. Her own hope is for a new system of education by which the child would "begin to be a useful member of the community from the age of three onwards. . . . In this way children would not be felt to be a burden either to those immediately responsible for them or to the community as a whole."

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[1] R. Pearl, *Jour. Exp. Zool.*, 63: 57–84, 1932.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

DEMONSTRATION OF BEAT NOTE AND OTHER ACOUSTIC PHENOMENA

THE phenomenon of beats and the principle of interference of sound waves is well known to every student of acoustics. It is commonly recognized that beats may give rise to a differential tone when the difference in frequencies of two loud sources of sound is sufficiently great to make a musical tone. However, the student is seldom given an opportunity to observe such tones for himself. A simple and convincing demonstration of beat-note and other phenomena is possible with an inexpensive apparatus, which may be readily constructed. It consists of two shrill variable-pitch metal whistles blown simultaneously through a T-tube. On account of the high frequencies emitted, only a small musical interval is required to produce a loud beat-note sufficiently removed in pitch from the whistles to be readily recognized by even an untrained ear. Furthermore, the beat-note may be caused to rise and fall two or three

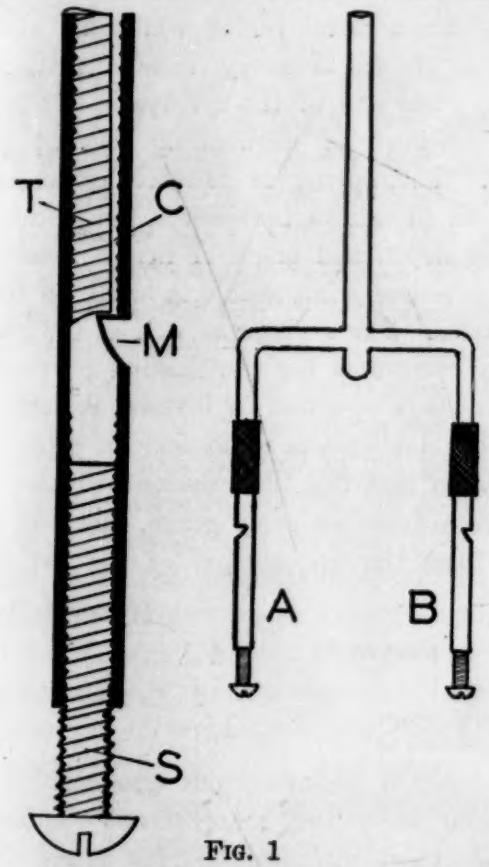

FIG. 1

octaves by altering the pitch of one whistle only two or three half-tones, while the other whistle remains steady. It is easy to show that the variable low-pitch sound is in reality a Helmholtz combination tone by observing its disappearance when either whistle is silenced while the other continues to emit sound.

Each whistle consists of a 6 cm length of brass tube, 4 mm internal diameter, threaded internally by a 10-32 tap. The speaking mouth *M* is a v-shaped cut filed half way through the tube at its midpoint (detail, Fig. 1). A piece of 10-32 screw, *T*, flattened on one side to make a narrow air passage, *C*, is inserted in the upper end of the tube to direct the air against the lip of the pipe. It is held in position by a bit of solder. A movable 10-32 screw, *S*, controls the resonant length of the pipe and hence the pitch. The end of this screw is filed flat to make a smooth stop for the closed pipe. A drop of machine oil on the threads helps to lubricate the screw and make it airtight. Such a whistle gives a loud fundamental with an approximate range from 2,500 to 5,000 vibrations per second corresponding to an octave which includes the highest notes on the piano. It emits a tone rather free from harmonics unless strongly "overblown."

Three or four interesting phenomena may be effectively shown with this simple apparatus. (1) *Beat Note.* While maintaining whistle A at constant pitch, change whistle B from a pitch above to a pitch below A. Observe the beat-note, which sounds much like the whistling of the wind on a gusty day: at first this note falls in pitch, then disappears and finally returns to rise in pitch as B continues to fall below the pitch of A. It is especially striking to observe the change of B and the beat-note in opposition to each other. The whistle of the beat-note sounds very much like the heterodyne whistle obtained in tuning a regenerative radio receiver. (2) *Temperature Effect.* Tune the whistles to unison by eliminating the beat-note. Then, while both are sounding, hold a lighted match under one whistle. The differential tone again asserts itself, due to the increased velocity of sound and the consequent rise of pitch in the heated whistle. The flame of a Bunsen burner accentuates the effect. Both whistles should be blown through the T-tube to avoid spurious pitch variations due to change of blowing pressure. (3) *Gas Density Effect.* After tuning the whistles to unison, blow one whistle with air, the other with illuminating gas passing through a long rubber tube. At the moment the gas expels the air from the tube, the pitch rises markedly in the gas-blown whistle. Disconnect the tube from the gas outlet and again blow the whistle by air, noting the sudden fall in pitch which occurs when air again fills the whistle. The influence of gas-density on the velocity of sound is thus convincingly demonstrated; it may be rendered still more pronounced by using compressed hydrogen or carbon dioxide, the first to cause a rise in pitch, the second to cause a lowering. Incidentally, these whistles may be operated on the gas supply to produce steady high-pitched sources: simply ignite the gas to prevent its escape into the room. (4) *Doppler Effect.* Attach one whistle to a piece of rubber tubing 1.5 meters long. Swing the whistle in a horizontal circle while

blowing steadily through the tube. An observer seated outside the circle will hear the periodic rise and fall of pitch accompanying the approach and recession of the whistle. For this experiment a medium pitch is preferable to a high, since the *ratio* of pitches for approach and recession, $n_1/n_2 = V + v/V - v$, is independent of the "rest pitch" of the whistle, whereas the ear is more sensitive to variation of pitch at 2,500 vib./sec. than at 5,000.

Using whistles of smaller diameter than those described here, the author has pursued the beat-note phenomenon to the upper limit of audibility, where the beat-note disappears as soon as either whistle exceeds the audible range of the ear—in this case above 22,000 vib./sec.

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AUTOMATIC HYPODERMIC INJECTOR

SELF-ADMINISTRATION of medicine by the hypodermic method has become very common in recent years. Ever since Dr. Banting, of Toronto, in 1922, isolated the hormone insulin from the islands of Langerhans in the pancreas, the injection of this substance before each meal has become the recognized treatment of diabetes. The hormones of other internal secretory glands are being isolated, and promise to become control medication in various deficiency diseases. Being of organic chemical composition, hormones are digested when taken by mouth, and must be injected subcutaneously to give their systemic effect. Patients who suffer from a hormone deficiency must have the substitute injections so frequently, usually several times a day, that it becomes impractical to have them administered by a doctor or a nurse, and necessitates the patients giving themselves the injections. Besides hormones, other substances that must be injected frequently over a prolonged period of time, such as hay fever vaccine, for example, are best administered by the patients themselves.

Hypodermic self-injection, however, has the drawback that ordinarily it is painful. And to inflict pain upon oneself is against the deep-rooted instinct of self-preservation. The fear of pain causes a hesitancy on the part of the patient when he is about to push in the needle. Hence the procedure becomes slower and more awkward than it need be. Slower penetration results in more distortion of the skin, more stretching and tearing of the sensitive nerve endings, and consequently more pain.

Due to this drawback many diabetic patients are denying themselves the health-preserving and life-saving benefits that insulin would give them. Diabetes is markedly on the increase, involving over a half million people in this country alone, and has climbed into tenth place in the list of death causes. In order to encourage diabetics to use insulin, an automatic injector has been perfected, which eliminates pain by the extreme rapidity with which the needle is plunged into the tissues, and which substitutes an automatic thrust for the fearful manual push.

The automatic injector consists of a compression spring, within a metal casing which fits around the upper end of an ordinary insulin syringe. The calibrated lower end of the syringe is left uncovered so that the dose of medication may be properly measured. The spring is released by means of a trigger. An adjustable foot-rest at the bottom assures the correct depth and angle of needle insertion, and makes it practically impossible to break off the needle in the tissues. The syringe as well as the needle are separately removable for sterilization purposes. The injector is easily operated by laymen, is very durable, and last but not least is reasonable in price.

It is hoped that this little device will save many a timid person from an early grave, and will dislodge diabetes from the upper part of the list of death causes.

HERBERT BUSHER

ST. PAUL, MINNESOTA

SPECIAL ARTICLES

THE ERGOT ALKALOIDS

A RECENT preliminary report[1] has been made of the isolation of proline (as the double gold salt of its methyl ester) after hydrolysis of ergotinine in methyl alcoholic hydrochloric acid solution and also from among the products of the reductive cleavage of this alkaloid with sodium in butyl alcohol. Among the products of the latter we have also obtained several other bases, one of which was interpreted as a substituted piperazine, $C_{14}H_{20}N_2$, resulting possibly from the reduction of the mixed anhydride of proline and phenylalanine and another base, a phenylpropanolamine, possibly a phenylalanine product. These interpretations have been more recently substantiated by the isolation of phenylalanine itself from the products of the alkaline hydrolysis of ergotinine. Thus ergotinine and therefore ergotoxine are built up of the four constituents, lysergic acid (as its amide, ergine) isobutyryl formic acid, proline and phenylalanine. The accepted formula for ergotinine, $C_{35}H_{39}O_5N_5$, is consistent with the conjugation of these components (in peptide linkage) with the loss of three moles of water.

We have more recently made a preliminary study of ergotamine (obtained from the ergotamine tartrate of the Sandoz Chemical Works) by the same methods.

[1] W. A. Jacobs and L. C. Craig, *Jour. Am. Chem. Soc.*, 57: 383, 1935; *Jour. Biol. Chem.*, 108: 595, 1935.

Although hampered by a very limited amount of material, suggestive results have been secured. In addition to lysergic acid and ammonia,[2] phenylalanine has been obtained from it. Less success, however, was experienced in our attempts to obtain proline as the gold salt of its ester from the alkaline hydrolysis of ergotamine or after its reductive cleavage with sodium in butyl alcohol. However, in the latter case we have isolated in addition to α- and β-dihydrolysergol the picrate of the piperazine, $C_{14}H_{20}N_2$, corresponding with that obtained from ergotinine. There can be little doubt, therefore, that proline is also a constituent of ergotamine. This conclusion was supported by the strong pyrrol test given by the mixed amino-acid fraction obtained from the alkaloid after alkaline hydrolysis.

In another respect, however, we have noted a striking difference between ergotinine and ergotamine. By no method have we succeeded in detecting either isobutyryl formic acid as such, or its reduction product α-hydroxyisovaleric acid, as products of the cleavage of ergotamine.

Since the accepted formula for ergotamine is $C_{33}H_{35}O_5N_5$, which differs therefore from that of ergotinine by C_2H_4, the possibility was considered by us that in ergotamine and therefore also ergotaminine pyruvic acid occurs in place of the isobutyryl formic acid of ergotinine and ergotoxine. Our experience has given support to this suggestion. If ergotamine is heated a short while with dilute alcoholic alkali, the resulting solution gives a red color with nitroprusside similar to that given by pyruvic acid and which changes after addition of ammonium chloride through purple to blue. This reaction is not given by ergotinine under the same conditions. In addition, it has been possible to obtain in very small yield a phenylhydrazone from the acid fraction of the cleavage products of ergotamine, which gave the same melting point (189–190°) as the phenylhydrazone of pyruvic acid. A mixture of the two showed no depression.

On pyrolysis of ergotamine and under conditions which with ergotinine gave isobutyryl formamide without difficulty, none of the latter substance was obtained from ergotamine. Other crystalline substances, however, were found in the sublimate which are now under investigation.

It is suggested that while ergotinine and ergotoxine are derivatives of lysergic acid, isobutyryl formic acid, proline and phenylalanine, in ergotamine and therefore ergotaminine isobutyryl formic acid is replaced by pyruvic acid.

Lysergic acid has probably a biogenetic relationship to tryptophane and isobutyryl formic and pyruvic acids to valine (hydroxyvaline?) and alanine (serine?), respectively.

We are attempting to confirm these findings by further investigations.

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[2] This is in agreement with the isolation of ergine from this alkaloid by Smith and Timmis (*Jour. Chem. Soc.*, 1932: 1543).

ASCORBIC ACID (VITAMIN C) AND PHOTOGRAPHIC DEVELOPING ACTION

UNTIL recently, knowledge of the chemistry of vitamin C was limited to assumptions drawn from the behavior of antiscorbutic concentrates. The experiments of the early investigators were reviewed by McCollum and Simmonds[1] in 1929 and by Sherman and Smith[2] in 1931. The evidence indicated that vitamin C was a reducing substance which was highly susceptible to oxidation in alkaline solution but comparatively stable in acid and which gave some of the reactions of polyphenols.

These properties so strongly reminded me of the photographic developing agents that, in 1931, I prepared an antiscorbutic concentrate from decitrated lemon juice, made it alkaline and tested it for developing action. It produced faint blackening on light-struck photographic emulsion. Thus encouraged, I reversed the procedure, testing numerous developing agents for antiscorbutic action. Needless to say, this attempted short cut to the identification of vitamin C was unsuccessful; still the developing action of the lemon juice concentrate remained to be explained. Following the recent isolation and synthesis of vitamin C (*l*-ascorbic acid),[3] I have employed the commercial product in a resumption of the photographic experiments.

Ascorbic acid, dissolved in water with sodium sulphite (preservative) and sodium carbonate (accelerator) in the usual proportions of a developing solution, is a rapid developer which produces a black image and considerable fog. It is unusually sensitive to bromide (restrainer). As little as 20 mgm of potassium bromide per liter of solution markedly restrains fog, considerably slows development, requires longer exposure and changes the color of the image from black to brown. The developing action is illustrated by experiments with Formula 1, prepared by dissolving the chemicals in the order indicated. This solution, in a stoppered bottle, remains usable for about a week.

[1] E. V. McCollum and N. Simmonds, "The Newer Knowledge of Nutrition," 4th ed., New York, Macmillan, 1929.

[2] H. C. Sherman and S. L. Smith, "The Vitamins," 2nd ed., New York, Chemical Catalog Company, 1931.

[3] L. J. Harris, *Ann. Rev. Biochem.*, 3: 264, 1934.

FORMULA 1 (FOR REDDISH BROWN TONES)

Distilled water	1000.0 cc
Sodium sulphite, anhydrous	12.5 gm
Sodium carbonate, anhydrous	12.5 "
Potassium bromide	0.1 "
l-Ascorbic acid	5.0 "

Prints of a landscape were made on representative "chloro-bromide" papers (Noko, Azo and Velox) and on one bromide paper (Eastman P.M.C.). The relative sensitivities of these emulsions, based on development in ordinary developers, were no guide to the exposures required of prints to be developed in vitamin C. Noko No. 0, the slowest of the papers, required twice its usual exposure. It gave prints with reddish black shadows and pinkish highlights. Azo No. 2, a slightly more sensitive paper, required 10 times its normal exposure. It gave copper-colored prints of good quality. Velox No. 2, a still more sensitive paper, required about 6 times its normal exposure. It gave brown prints of mediocre quality. The highly sensitive bromide emulsion of P.M.C. No. 2 developed so slowly, in spite of relatively long exposures, that chemical fog ruined the prints before density could be built up. The optimal period of development for each emulsion was 7 minutes at 23°. Fog became noticeable in 8 minutes, serious in 15 minutes. There was no stain. The images appeared orange or light brown when wet and darkened to their final color on drying.

In Formula 2, I replaced the sodium carbonate of Formula 1 by a stronger alkali, trisodium phosphate, and increased the amount of bromide. This solution should be used within one or two days.

FORMULA 2 (FOR BROWNISH BLACK TONES)

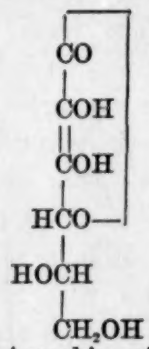
Distilled water	1000.0 cc
Sodium sulphite, anhydrous	12.5 gm
Trisodium phosphate, hydrous	40.0 "
Potassium bromide	0.5 "
l-Ascorbic acid	5.0 "

Prints were made on Azo No. 2 paper. The required exposure was 3 times the normal. The optimal period of development was 3 minutes at 23°; the fog limit, 4 minutes. There was no stain. In fresh solution the images were brownish black, of good quality. Older solutions gave increasingly brown tones.

That the (photographic) reduction potential of vitamin C is low in comparison with other developers is indicated by the sensitiveness of ascorbic acid to the restraining action of bromide.[4] This low reducing energy and a comparatively high fogging power are doubtless related to the anomalous properties which Green[5] observed in his study of the potentials of this reversibly oxidizable substance.

The developing action of ascorbic acid is a fact of importance in the theory which relates developing function to molecular configuration. It should be recalled that not all reducing agents are developing agents. While innumerable organic compounds, including vitamin C, reduce silver nitrate, only a few have the power to reduce the latent image in silver halide emulsions. The classical studies of A. and L. Lumière[6,7] on the *fonction développatrice* showed that this special reducing ability is confined, except for a few inorganic substances, to benzene derivatives in which there are two hydroxyl or two amino, or one hydroxyl and one amino groups, in the ortho or para positions. A partial exception is found in some naphthalene compounds, but in general the Lumière rule has held for over 40 years.

Ascorbic acid, a sugar derivative, is an outstanding exception, as is shown by its formula in comparison with that of a typical developer within the rule. In all probability, it is but one of a series of exceptions.



l-Ascorbic acid

p-Aminophenol

Those who are interested in the chemistry of photography will want to investigate the developing action of the analogues, homologues and derivatives of ascorbic acid and the related reductones, especially since a considerable number of such compounds have been described in recent months.[3,8]

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[4] A. H. Nietz, "The Theory of Development," New York, Van Nostrand, 1922.

[5] D. E. Green, *Biochem. Jour.*, 27: 1044, 1933.

[6] A. Lumière and L. Lumière, *Bull. Soc. franc. Phot.*, ser. 2, 7: 310, 1891.

[7] A. Seyewetz, "Le Négatif en Photographie," 2nd ed., Paris, Doin, 1923.

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